Integrated Disinfection Byproducts Mixtures Research: Assessing Reproductive and Developmental Risks Posed by Complex Mixtures of Disinfection By-Products

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Chemical disinfection of drinking water causes the formation of complex chemical mixtures of disinfection by-products (DBPs). Exposure to DBPs is of high concern to national, state, and local regulatory organizations responsible for assuring safe drinking water. The composition of DBP mixtures is highly variable and includes compounds that have not been chemically identified. Chemical disinfection of drinking water results in nearly ubiquitous exposures to DBPs in recipients of treated water. In some epidemiologic studies, exposures to DBPs have been associated with increased risks of reproductive and developmental effects, such as spontaneous abortions and low birth weights. Toxicological studies of individual DBPs indicate that some DBPs may be reproductive and developmental toxicants. However, the overall evidence is inconclusive. Although 11 DBPs are regulated in U.S. drinking waters, concerns persist about the toxicity of DBP mixtures and the possible need for additional regulations to reduce concentrations of additional DBPs. Four laboratories in the U.S. Environmental Protection Agency's (U.S. EPA) Office of Research and Development (ORD) are jointly undertaking a study to evaluate the reproductive toxicity associated with concentrated DBP mixtures. This poster presents a toxicologically based risk assessment strategy for identifying the individual components or fractions of a complex mixture that are associated with its toxicity. To illustrate the strategy, information is used on the toxicity of two concentrated whole mixtures of DBPs generated during the planning phase of the U.S. EPA's study. Analysis of these data suggests improvements in experimental design may be appropriate. These may include an increase in DBP concentrations, changing the experimental strain of rat used, changing the bioassay utilized to evaluate toxicity of the mixture, and appropriately powering such a study. Finally, the importance of developing statistical and toxicological methods for evaluating the similarity of different mixtures based on component composition and component toxicity is identified. Collaborative efforts outside of the U.S. EPA are being developed for key aspects of this study to enhance the understanding of the issues and provide effective analysis. Results of this effort will be critical in the health assessment of DBPs by the U.S. EPA, its regions, and the states.